

Cyanobacterial toxin removal in drinking water treatment processes and recreational waters

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Cyanobacterial algal toxins are an emerging national and international recreational water and drinking water issue. Newspaper headlines, recreational water closings, and reported animal deaths have increased public awareness and generated a pool of federal, state and local research funding for pure and applied research. The scientific community must review and evaluate past and current treatment studies to prioritize and to provide goals for future source water and drinking water treatment projects.

Most drinking water utilities insure potable water by using a source-to-tap multi-barrier water treatment approach. The multi-barrier approach recognizes both individual as well as the inter-relationship (i.e. systems approach) between procedures, unit processes and tools that cooperatively prevent and reduce contamination of drinking water. In order to propose relevant source and drinking water research the multi-barrier approach must be understood by the scientific community. A short review of this multi-barrier approach in the context of the removal and inactivation of algal toxins will be presented and discussed.

Although federal source and drinking water regulations determine the finished water product, many factors influence how each utility chooses to treat its source water. Some of the practical considerations include source water quality and quantity, storage capacity, existing unit processes, and space. An overview of the United States recreational and drinking water regulations will be discussed in the context of cyanobacterial toxin removal and inactivation by ancillary as well as auxiliary treatment practices. Ancillary practice refers to the removal and inactivation of algal toxins by standard daily operational procedures where as auxiliary treatment practice refers to intentional modification of the standard treatment. An example of auxiliary treatment would be the addition of powder activated carbon to remove taste and odor compounds. The impact of the Enhanced Surface Water Treatment Rule and Disinfectant/Disinfection Byproduct Rule will also be discussed from the perspective of algal toxin removal and inactivation. New technologies that meet current and purposed regulations such as ultraviolet disinfection, membrane filtration and ion-exchange, can greatly affect the removal and inactivation of algal toxins. We will describe how compliance with the DBPR through modified chemical disinfection processes using ozone, chlorine, chloramines, and chlorine dioxide may alter the degree of algal toxin inactivation. Although much of the treatment research has focused on the efficiency, the removal, and inactivation of microcystin LR (the most common algal toxin) and several microcystin variants, our discussion will include other common algal toxins such as anatoxin-a and cyclindrospermopsin.